Heights of rivers above zeros of gauges, 1898—Continued.

Stations.	Highest water.		Lowest water.		Mean stage.	Annual range.
	Stage.	Date.	Stage.	Date.		
	Feet.		*Feet.*		*Feet.*	*Feet.*
James River.						
Lynchburg, Va	12.0	Oct. 22	—0.2	Sept. 18, 21, 22	1.6	12.2
Richmond, Va	11.7	Oct. 24	—0.2	July 5, 14–17; Sept. 14–18, 23	1.0	11.9
Alabama River.						
Montgomery, Ala	28.0	Oct. 10	—0.8	June 13	5.0	28.8
Selma, Ala	28.5	Oct. 11	—1.3	June 12, 14, 15	6.6	29.8
Coosa River.						
Rome, Ga	24.3	Sept. 4	2.0	July 2–5	3.7	22.3
Gadsden, Ala	22.0	Oct. 8	—0.3	July 5–8	4.8	22.3
Tombigbee River.						
Columbus, Miss	21.5	Jan. 25	—3.7	Sept. 19, 20	5.4	25.2
Demopolis, Ala	46.0	Feb. 1	—3.0	Sept. 20, 21	8.5	49.0
Black Warrior River.						
Tuscaloosa, Ala	43.5	Jan. 27	—1.0	Oct. 5	6.4	44.5
Pedee River.						
Cheraw, S. C	29.5	Aug. 22	0.4	July 5	3.7	29.1
Black River.						
Kingstree, S. C	10.7	Nov. 30	0.2	June 18	4.8	10.5
Lumber River.						
Fairbluff, N. C	5.2	Sept. 3–7	—0.9	June 13–18	2.4	6.1
Lynch Creek.						
Effingham, S. C	13.8	Nov. 26	1.7	June 16, 17	5.6	12.1
Potomac River.						
Harpers Ferry, W. Va	15.5	Aug. 12	0.4	July 19–21	3.0	15.1

Heights of rivers above zeros of gauges, 1898—Continued.

Stations.	Highest water.		Lowest water.		Mean stage.	Annual range.
	Stage.	Date.	Stage.	Date.		
	Feet.		*Feet.*		*Feet.*	*Feet.*
Roanoke River.						
Clarksville, Va	10.4	Sept. 25	0.0	July 4, 5; Sept. 19–22	1.4	10.4
Sacramento River.						
Red Bluff, Cal	12.0	Feb. 28	—0.8	Aug. 26–31; Sept. 1–14	1.6	12.8
Sacramento, Cal	16.7	Mar. 10	7.1	Sept. 13–21	10.0	9.6
Santee River.						
St. Stephens, S. C	8.7	Sept. 3–7	—2.0	June 15, 16	3.8	10.7
Congaree River.						
Columbia, S. C	15.8	Aug. 28	—0.9	May 25, 26	2.1	16.7
Wateree River.						
Camden, S. C	25.2	Oct. 7	0.9	July 5	6.6	24.3
Savannah River.						
Augusta, Ga	28.4	Sept. 2, 3	3.3	July 6	8.9	25.1
Susquehanna River.						
Wilkesbarre, Pa	17.9	Jan. 16	—0.4	July 18–30	4.2	18.3
Harrisburg, Pa	15.2	Mar. 24, 25	0.7	July 18, 19; Oct. 3–7	3.9	14.5
Juniata River.						
Huntingdon, Pa	10.2	Mar. 23	2.7	Oct. 17, 18	4.3	7.5
W. Br. of Susquehanna.						
Williamsport, Pa	21.0	Mar. 24	0.4	Sept. 19, 21, 23–25	3.3	20.6
Waccamaw River.						
Conway, S. C	5.6	Dec. 13, 14	0.1	June 16	2.5	5.5

[a] July 24–27, Sept. 25–30, Oct. 1–21.

GENERAL CLIMATIC CONDITIONS.

By ALFRED J. HENRY, Chief of Division of Records and Meteorological Data.

ATMOSPHERIC PRESSURE.

The mean pressure for 1898 is shown numerically in Tables I and II. The method of reduction to sea level and the omission of the gravity correction, as explained by Professor H. A. Hazen, in the MONTHLY WEATHER REVIEW for 1894, Vol. XXII, page 538, have continued in use during the year and the figures given in Tables I and II are the mean pressures obtained by the use of Professor Hazen's method of reduction.

In conformity with the practice of former years the observed mean pressures have also been reduced to standard gravity and to sea level by the tables and methods of the International Meteorological Committee, as explained in the MONTHLY WEATHER REVIEW for 1895, Vol. XXIII, pages 492–494. The results obtained by the last method are shown in Table III and on Chart I. The data in the last column of Table III are the pressures at 10,000 feet above sea level, obtained by assuming a uniform decrement of temperature at the rate of 2° F. per 1,000 feet (0.37° C. per 100 meters) as in former Annual Summaries; the resulting isobars are shown on Chart II.

The distribution of mean pressure at sea level, as shown by Chart I, does not differ appreciably from that of former years. The Plateau High is perhaps a little farther to the northwestward and nearer the coast than during previous years, and the Arizona Low is a little deeper than usual, and extends farther to the northwestward into California. The trough of low pressure extending from the lower Rio Grande Valley into the British Possessions is rather well marked. East of the Mississippi River the distribution agrees closely with that of former years.

The high-level pressures on Chart II do not differ appreciably from those of former years. The high-level gradients, it will be seen, are much steeper than those at sea level, particularly east of the Rocky Mountains. West of the mountains, however, and particularly on the Pacific coast, the high-level gradients appear to have been weaker than usual. We are disposed to associate the pressure distribution on the Pacific coast with the remarkable drought that has existed in that locality for more than a year past. The extension of the Plateau high to the northwestward over eastern Oregon and northeastern Washington already noticed, is generally coincident with a shifting to the northward of the atmospheric disturbances which ordinarily strike the coast of Washington and Oregon and move eastward between latitude 45° and 50°. The deepening of the trough of low pressure that parallels the eastern foothills of the Rocky Mountains would seem to indicate a movement of low area storms southeastward from the Northwest Territories. The fact that precipitation was above normal generally throughout the greater part of the eastern foothills and plains, seems to lend confirmation to the belief that the cause of drought on the Pacific coast must be looked for in the changes or modifications of the general air movements over the Rocky Mountain and Plateau regions. Such changed or modified motion must necessarily produce variations in rainfall distribution, temperature, and other weather conditions, but the problem is as yet obscure.

TEMPERATURE.

The year opened with high temperature for the season east of the Rocky Mountains and cold weather in the Plateau region and on the middle and south Pacific coasts. The mild temperatures east of the Rocky Mountains continued throughout February and March, the winter being unusually mild, especially in North Dakota, the Lake region, and the Missouri and upper Mississippi valleys.

Interlake navigation opened much earlier than usual. The Straits of Mackinac were free from ice on March 28, the earliest date but one during the sixty-three years that records have been kept. While navigation opened much earlier than usual its close was marked by one of the greatest ice blockades at the west end of Lake Erie in the history of lake navigation. The cold weather during the early part of December froze the water in sheltered bays to a depth of 6 to 8 inches. Great fields of ice formed in the highway of vessels between the mouth of the Detroit River and points to the eastward, in which a fleet of nearly one hundred vessels was soon imprisoned, The vessels were held in the ice jam about ten

TABLE A.—*Average monthly and annual departures of temperature from the normal during* 1898.

Districts.	Number of stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
New England	10	+ 0.2	+3.5	+ 6.6	−0.9	−1.1	−1.2	+0.2	+2.5	+2.3	+2.0	0.0	−0.7	+1.1
Middle Atlantic	12	+ 3.1	0.0	+ 7.4	−1.5	−0.5	+0.1	+1.7	+2.4	+2.7	+2.1	−0.3	−0.5	+1.5
South Atlantic	10	+ 4.2	−3.3	+ 5.4	−2.7	+1.9	+0.5	+0.1	+1.1	+2.2	+1.3	−1.1	−0.6	+0.8
Florida Peninsula	7	+ 1.0	−3.1	+ 2.0	−1.0	−0.2	+0.4	−0.2	−0.7	+0.7	−0.1	+1.0	−0.6	−0.1
East Gulf	7	+ 4.5	−2.6	+ 3.9	−4.2	+1.8	+1.5	−0.6	−0.3	+1.3	−2.0	−2.4	−3.3	−0.
West Gulf	7	+ 6.0	+2.6	+ 1.8	−2.4	+1.8	+0.7	−0.3	+1.3	+2.1	−0.4	−2.7	−6.0	+0.3
Ohio Valley and Tennessee	12	+ 5.3	−1.1	+ 7.1	−3.8	+2.0	+1.9	+1.3	+2.0	+3.9	+0.4	−1.4	−3.3	+1.2
Lower Lake	8	+ 3.9	+1.4	+10.0	−0.5	+1.1	+1.4	+2.2	+2.4	+3.7	+2.0	−0.1	−2.1	+2.2
Upper Lake	9	+ 5.6	+3.0	+ 7.7	+1.0	+1.6	+0.5	+1.3	+0.8	+3.8	+0.7	+1.8	−3.2	+2.0
North Dakota	7	+15.1	+7.5	− 0.2	+0.7	−0.1	−0.8	−0.3	+0.9	+1.6	−4.3	−2.5	+0.6	+1.5
Upper Mississippi	11	+ 7.7	+2.6	+ 5.4	−1.3	+0.8	+1.9	+0.2	+0.8	+3.5	−2.0	−1.1	−5.2	+1.1
Missouri Valley	10	+ 9.2	+6.4	+ 3.2	−1.6	+0.4	+1.8	−0.3	+1.9	+2.5	−3.2	−2.0	−5.1	+1.1
Northern Slope	7	+ 5.0	+9.2	− 5.2	+0.7	−1.7	+0.1	−0.6	+2.6	+0.5	−4.6	−2.8	−2.8	0.0
Middle Slope	6	+ 3.6	+6.2	− 0.4	−0.5	−0.9	+1.2	−0.4	+1.9	+0.6	−1.7	−2.4	−6.8	+0.1
Southern Slope	5	+ 4.2	+6.0	+ 1.7	−0.9	+0.2	−1.2	−1.6	+1.0	+0.2	+0.6	−1.6	−8.8	0.0
Southern Plateau	13	− 3.1	+3.7	− 3.1	+3.2	−1.6	−0.8	+0.1	+1.2	+1.7	+0.5	−0.3	−4.2	−0.4
Middle Plateau	9	− 8.0	+4.0	− 5.7	+3.8	−3.3	+0.9	+0.9	+2.7	+1.8	−2.7	−2.3	−5.1	−1.0
Northern Plateau	11	− 1.8	+8.6	− 2.6	+2.2	−2.0	+1.2	+0.3	+3.7	+1.4	−2.6	−3.3	−8.1	−0.2
North Pacific	9	+ 0.9	+4.2	− 2.1	+0.5	+0.4	+1.4	+0.4	+1.9	+1.7	−0.2	−0.8	−1.9	+0.6
Middle Pacific	5	− 2.8	+1.8	− 2.4	+1.3	−3.3	+1.1	−0.3	−0.4	−0.9	+1.5	−1.2	−1.4	−0.6
South Pacific	4	− 2.7	+2.4	− 1.6	+3.0	−2.2	+1.3	+0.7	+1.5	+0.9	+0.6	0.0	+0.2	+0.3

days, being released by car ferries and powerful tugs, at an expense of from $15,000 to $18,000.

There were several periods of very warm weather during July and August, the temperatures registered at a few stations east of the Appalachians being higher than ever before known. During the latter part of July and at intervals during August, periods of high temperature conjoined with high relative humidity, prevailed in the central and eastern portions of the country and much bodily discomfort was experienced.

Temperature continued above normal generally until October, when a reversal of the prevailing conditions took place, such reversal being first observed in the Rocky Mountain and Plateau regions, where the temperature averaged from 1° to 4° below normal. The temperature was also below normal in October quite generally throughout the northwest and also in the Gulf States, but remained above normal in the Lake region, the Ohio valley, and Tennessee.

The reversal noted as beginning in October was almost completely established during November, when the only districts showing plus departures were the Florida peninsula and the upper Lake region. In December temperature was below normal in practically all districts, the departures averaging from 1° to 8° below normal. Table A shows in condensed form the march of temperature during the year.

The average annual surface temperature is shown on Chart III by red lines, while the annual extremes are indicated by full and broken lines, respectively. The numerical values appear in Tables I and II.

PRECIPITATION.

The precipitation of the year just ended was below normal over by far the greater part of the United States. Fortunately, however, there was an abundance of rain generally throughout the middle portion of the central valleys and the Middle and New England States. Precipitation was below normal west of the Rocky Mountains, in the upper Mississippi and upper Missouri valleys, and from New Mexico eastward to the Atlantic. The normal precipitation over much the greater part of the last-named area, however, is more than sufficient for the needs of agricultural interests, the conditions as regards those interests were, therefore, not so unfavorable as they might otherwise have been.

TABLE B.—*Monthly and annual departures of precipitation from the normal during* 1898.

Districts.	Number of stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
New England	10	+0.6	+1.5	−1.3	+1.5	+1.3	−1.4	+0.4	+0.8	−1.3	+2.5	+2.2	−1.1	+ 5.7
Middle Atlantic	12	−0.7	−1.3	−1.1	+0.2	+1.4	−1.2	0.0	+1.4	−1.5	+2.0	+0.8	−0.7	− 0.8
South Atlantic	10	−2.7	−2.5	−1.6	0.0	−1.7	−1.3	+1.7	+2.0	−2.2	+1.5	+1.0	−0.9	− 7.1
Florida Peninsula	7	−2.3	−1.4	−0.8	−0.9	−2.4	−3.2	−0.3	+3.6	−2.7	+5.2	−0.8	+0.7	− 5.4
East Gulf	7	−2.5	−0.3	−3.2	−1.5	−3.4	−2.0	+0.3	+3.8	+7.4	+2.2	+1.9	−0.4	+ 1.1
West Gulf	7	+0.5	−1.2	+0.3	−1.6	−1.0	+0.9	−0.9	−0.6	+0.7	−0.5	−0.6	−0.9	− 4.8
Ohio Valley and Tennessee	12	+2.9	−2.7	+2.0	−1.4	−0.5	−0.4	0.0	+0.4	+0.9	+1.0	−1.1	−1.3	− 0.3
Lower Lake	8	+1.2	−0.1	+0.6	−0.6	−0.8	−0.9	−0.4	+0.2	0.0	+1.1	−0.1	−0.1	0.0
Upper Lake	9	+0.3	+0.5	+0.9	−1.0	−0.8	0.0	−1.1	+0.5	−0.8	+1.0	−0.7	−1.0	− 2.2
North Dakota	7	−0.5	0.0	+0.4	−0.4	0.0	−1.1	−0.8	−0.5	−0.2	+0.8	−0.3	−0.4	− 3.1
Upper Mississippi	11	+1.1	−0.4	+2.6	0.0	+1.1	−0.7	−0.4	+0.3	+0.9	+1.9	−0.3	−1.2	+ 5.0
Missouri Valley	10	+0.4	−0.4	+1.0	−0.2	+1.2	+1.2	+0.1	−0.6	+0.5	+0.3	−0.3	−0.5	+ 1.9
Northern Slope	7	−0.3	−0.3	+0.5	−0.5	+1.3	−0.4	−0.2	−0.7	+0.1	+0.3	+0.1	−0.2	− 0.2
Middle Slope	6	+0.8	+0.4	−0.6	−0.1	+3.0	−0.2	−0.1	−0.9	0.0	0.0	0.0	+0.5	+ 2.8
Southern Slope	5	0.0	−0.4	0.0	−0.4	+0.2	+1.4	+0.8	+0.2	−0.3	−1.6	−0.2	+1.0	+ 0.7
Southern Plateau	13	+0.3	−0.6	−0.1	+0.2	−0.3	+0.1	−0.4	+0.1	−0.6	−0.5	−0.1	−0.1	− 1.6
Middle Plateau	9	−1.1	−0.7	−0.2	−0.6	+1.0	−0.1	−0.2	+0.2	−0.4	+0.1	+0.5	−0.9	− 2.5
Northern Plateau	11	−0.8	−0.7	−0.8	−0.6	+0.4	−0.4	0.0	+0.2	−0.4	−0.7	+0.8	−1.2	− 4.2
North Pacific	9	−3.1	+3.2	−3.0	−1.4	−0.8	+0.3	−0.4	−0.6	+0.4	−1.2	+0.5	−2.2	− 8.4
Middle Pacific	5	−4.0	+0.6	−3.5	−1.6	+0.5	−0.1	−0.1	0.0	+0.1	−0.6	−1.5	−3.7	−14.0
South Pacific	4	−1.6	−1.6	−1.3	−1.2	+0.7	−0.1	0.0	0.0	+0.2	−0.5	−1.2	−2.6	− 9.2

The drought which began in California in the fall of 1897 continued until May, 1898. In the latter month which practically closes the rainy season on the Pacific coast, heavy rains fell in California and the Plateau region. The rainy season of 1898–99 in California began auspiciously, the September rains being above the average. The fall during October, November, and December was, however, below the average and at the close of the year grave apprehensions were entertained of a second season of diminished rains.

In the Gulf and South Atlantic States the fall was below the average, although the deficiency was not so great as in former years. The precipitation of this region has been below normal with unimportant exceptions since 1890. It would be exceedingly interesting to discover the cause of the continued diminution.

The geographic distribution of precipitation is shown on Chart IV, and the numerical values for regular Weather Bureau and Canadian stations only, appear in Tables I and II. It is not practicable to publish the records of voluntary stations in this summary.

HUMIDITY.

The humidity observations of the Weather Bureau are divided into two series; the first or tridaily series began in 1871 and ended with 1887; the second or twice-daily series is continuous from 1888 to the present time.

The monthly means of the second or present series are based upon observations of the whirled psychrometer at 8 a. m. and 8 p. m., seventy-fifth meridian time, which corresponds to 5 a. m. and 5 p. m., Pacific; 6 a. m. and 6 p. m., Mountain; and 7 a. m. and 7 p. m., Central standard time.

Mean values computed from the first series are naturally not directly comparable with those of the second. In general the means of the first series are lower than those of the second, since they include an observation in the afternoon when the relative humidity of the air is near the minimum of the day. At stations in the western plateau region, however, the converse holds good, the means of the second series being lower than those of the first by amounts ranging from 0 to 10 per cent on the average of the year.

In the present state of knowledge respecting the diurnal variation in the moisture of the air, we are scarcely warranted in combining the two series in a general mean.

The monthly and annual departures of average relative humidity from the normal are shown in condensed form in the table below. The dryness on the Pacific coast and the southwest is the most striking feature of the year.

In using the table by means of which the amount of moisture in the air is computed from the readings of the wet and dry bulb thermometers, the pressure argument has almost always been neglected, an omission that has little significance except for low temperatures and at high stations, such as Santa Fe, El Paso, Cheyenne, and a few others. The failure to apply a correction for the influence of pressure on the evaporation and therefore on the temperature of the wet-bulb thermometer has had the effect of making the monthly means of relative humidity at high-level stations too small by quantities ranging from 5 to 10 per cent. In the application of the monthly averages of the above table, or those of individual stations in Table I, to special inquiries, whether in the departments of biology, climatology, or sanitary science, this fact should be kept in mind. It should also be remembered that the hours at which observations in the Rocky Mountain Plateau region are made, viz, at 5 or 6 local mean time, morning and afternoon, give approximately the maximum and minimum values of the relative humidity for the day; probably the means of such hours approach more nearly the true mean of the month than is the case on the Atlantic seaboard and in the seventy-fifth meridian time belt.

SUNSHINE AND CLOUDINESS.

The average cloudiness of the whole sky is determined by numerous personal observations at all stations during the daytime, and is given in the column "average cloudiness" in Table I.

The formation of fog and cloud is primarily due to differences of temperature in a relatively thin layer of air next to the earth's surface. The relative position of land and water surfaces often greatly increases the tendency to form areas of cloud and fog. This principle is perhaps better exemplified in the Lake region than elsewhere, although it is of quite general application. The percentage of sunshine on the lee shores of the Lakes is always much less than on the windward shores. Next to the permanent influences that tend to form fog and cloud may be classed the frequency of the passage of cyclonic areas.

The monthly and annual departures of average cloudiness from the normal during 1898 are exhibited in the table below. The data present no features calling for special comment.

TABLE C.—*Monthly and annual departures of relative humidity from the normal*, 1898.

Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
New England	0	+ 6	+ 5	+ 5	+ 2	+ 1	+ 2	+ 3	− 1	+ 5	+ 2	+ 1	+ 2.6
Middle Atlantic	0	− 1	+ 5	− 2	+ 6	− 2	+ 4	+ 5	− 1	+ 5	0	0	+ 1.6
South Atlantic	− 2	− 9	+ 7	− 4	− 1	− 2	+ 2	+ 4	− 1	+ 2	− 2	− 4	− 0.8
Florida Peninsula	− 3	− 8	− 4	− 5	− 5	− 7	+ 1	0	− 1	+ 2	− 1	0	− 2.6
East Gulf	+ 4	− 4	+ 8	− 5	− 5	0	0	+ 5	+ 5	+ 5	0	− 3	+ 0.8
West Gulf	+ 2	+ 1	+ 8	− 1	+ 2	+ 7	+ 2	+ 4	+ 5	+ 1	+ 1	0	+ 2.7
Ohio Valley and Tennessee	+ 2	− 1	+ 4	0	− 1	− 3	+ 2	+ 6	+ 4	+ 9	+ 1	0	+ 1.9
Lower Lake	− 1	0	− 1	− 4	+ 2	− 1	− 1	+ 5	− 1	+ 3	− 1	− 1	− 0.1
Upper Lake	+ 1	+ 3	+ 1	− 4	+ 2	+ 3	0	+ 5	− 1	+ 5	+ 2	+ 2	+ 1.6
North Dakota	− 3	− 5	− 2	− 4	− 3	+ 1	0	+ 1	− 1	+10	0	− 1	− 0.6
Upper Mississippi Valley	+ 1	0	+ 2	+ 1	+ 5	+ 2	− 1	+ 6	+ 3	+ 8	− 1	+ 2	+ 2.3
Missouri Valley	0	− 3	− 2	− 3	+ 5	+ 3	0	0	− 2	+ 5	− 6	0	− 0.2
Northern Slope	+ 2	− 4	+ 3	− 1	+ 5	+ 2	− 1	− 3	− 2	+ 2	0	+ 1	+ 0.3
Middle Slope	+ 3	− 3	− 2	+ 1	+ 8	+ 6	+ 1	− 1	+ 2	0	− 1	+ 6	+ 1.7
Southern Slope	0	−12	− 3	− 1	0	+ 8	+ 4	− 5	− 4	−11	− 1	+ 5	− 1.7
Southern Plateau	+ 1	− 7	− 5	+ 2	− 1	+ 4	− 1	− 5	− 9	−21	−10	+ 1	− 4.2
Middle Plateau	+ 4	+ 3	+ 6	+ 1	+11	+ 5	+ 2	− 1	− 6	+ 5	+ 4	− 2	+ 2.7
Northern Plateau	+ 3	− 3	0	− 5	− 2	+ 1	0	+ 1	0	+ 1	+ 7	0	+ 0.2
North Pacific Coast	− 4	− 5	− 5	− 7	− 6	− 5	− 6	− 1	− 5	− 6	− 1	− 6	− 4.8
Middle Pacific Coast	− 9	+ 1	−11	−10	0	− 1	− 5	− 3	− 2	− 7	− 8	−18	− 6.1
South Pacific Coast	− 7	0	−12	− 8	0	− 1	− 1	+ 1	− 1	− 3	−11	−18	− 5.1

TABLE D.—*Monthly and annual departures of average cloudiness from the normal*, 1898.

Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
New England	−0.2	+0.5	−0.2	+1.1	+1.1	+0.8	+0.6	+0.8	−0.5	+0.4	+0.7	+0.1	+0.4
Middle Atlantic	+0.6	−0.8	+0.9	+0.8	+1.0	−0.3	+0.4	+0.1	−1.0	+0.5	+0.6	+0.1	+0.2
South Atlantic	−0.5	−1.5	+0.7	−0.2	−0.8	−0.8	+0.8	+0.9	0.0	+0.8	+0.6	+0.8	+0.1
Florida Peninsula	−1.4	−1.1	−0.5	−0.9	−2.1	−2.4	−0.6	−0.6	−1.2	+0.5	+0.4	+0.4	−0.8
East Gulf	+0.1	−2.0	+0.9	−0.6	−1.4	+0.2	+0.4	+1.4	+1.4	−0.5	+0.8	+0.4	+0.1
West Gulf	+0.5	−1.7	+1.3	−0.6	−0.2	+1.1	+0.5	+0.2	0.0	−0.6	+0.7	−0.2	+0.1
Ohio Valley and Tennessee	+0.4	−0.1	+0.5	0.0	−0.4	−0.9	+0.4	0.0	−0.1	+1.1	+0.1	−0.6	0.0
Lower Lake	+0.5	+1.2	−0.5	+0.2	+1.0	−0.1	−0.3	+1.2	−0.4	+1.0	0.0	+0.4	+0.4
Upper Lake	0.0	+0.9	−0.2	−0.6	−0.3	+0.3	−0.9	+0.3	−0.4	+1.3	−0.3	−0.6	0.0
North Dakota	−0.7	−0.4	−0.3	−1.2	−0.9	0.0	−0.6	−0.6	−0.2	+1.4	−0.5	−1.1	−0.4
Upper Mississippi Valley	+0.2	+0.4	+0.1	−0.4	+0.4	−0.1	−0.6	+0.2	+0.1	+2.1	−0.4	−1.2	+0.1
Missouri Valley	−0.1	−0.7	−0.3	−0.4	+0.8	+0.1	−0.4	−0.8	−0.1	+1.9	−0.2	−0.6	−0.1
Northern Slope	−0.3	+0.1	+0.5	−0.3	+1.1	−0.4	−0.1	−0.1	−0.3	+0.6	0.0	−0.1	+0.1
Middle Slope	+1.1	−0.7	+0.7	+0.3	+0.6	+0.3	−0.3	−1.1	0.0	+0.6	+0.4	−0.4	+0.1
Southern Slope	+0.8	−2.1	+0.8	0.0	−0.5	−0.6	−0.2	−1.6	−0.4	−0.6	+0.6	−0.8	−0.4
Southern Plateau	+0.9	−0.7	−0.1	+0.2	+0.4	+0.3	+0.2	−0.1	−0.9	−0.6	−0.4	+0.2	0.0
Middle Plateau	+0.1	+1.1	+0.3	−0.9	+2.2	+0.2	+0.1	+1.1	+0.1	+1.0	+1.2	−0.7	+0.5
Northern Plateau	−0.5	+0.2	−0.9	−1.4	−0.4	−0.6	+0.6	−0.3	−1.1	−0.2	+1.2	−0.8	−0.4
North Pacific Coast	+0.4	+1.0	−0.8	−0.7	−0.6	−0.7	−1.0	+0.9	+0.3	+0.3	+0.8	−0.6	−0.1
Middle Pacific Coast	−0.3	+1.4	−1.2	−0.5	+1.2	+0.4	−0.1	+1.0	+1.0	+1.0	+0.5	−0.7	+0.3
South Pacific Coast	+0.5	−0.1	−1.3	−0.8	−0.2	−0.6	−0.7	0.0	−0.5	−0.6	−0.9	−0.6	−0.5

STORMS OF THE YEAR.

In classifying the storms of the year according to their natural differences it is convenient to recognize three main classes. The first class may properly include all disturbances, such as a thunderstorm or tornado, whose sphere of action is restricted to a single locality or neighborhood, or to a narrow path 25 to 30 miles long, and we may designate disturbances of this class as *violent local storms*. For the second class we may properly choose storms which extend over greater areas than those of the first class. To this class belong tropical or West Indian hurricanes. Finally, for the third class, we have the general storms of the middle latitudes whose distinguishing characteristics are very great horizontal extension and comparatively light winds around the outer margins, becoming violent as the center of the disturbance is approached. Storms of the last-named class reach their greatest development in winter and the transition periods of spring and autumn.

The general history of all storms that were reported to the Bureau during the year has been given in the successive MONTHLY WEATHER REVIEWS. It is not the purpose of this summary to repeat the details already published, but to bring together for future reference and as a matter of climatic history, the main facts concerning noteworthy storms of the year.

Violent local storms.—The frequency of thunderstorm days in the different months and in the several States and Territories is shown approximately by the figures of Tables V and VI. The first-named table has been prepared from reports of regular and voluntary observers in the several States and Territories. The figures set opposite the stations and shown graphically on Chart V, represent the number of thunderstorm days in each month in the immediate neighborhood of the stations named.

The figures of Table VI were obtained from the monthly registers of voluntary observers in each State and Territory. In order to ascertain the relative frequency of thunderstorms with a high degree of accuracy, it would be necessary to increase the number of reporting stations and to rearrange those now in operation. The figures of Table VI do not accurately represent the frequency of thunderstorms in all cases. This is due to several facts, among which we may mention (1), the failure of the great majority of voluntary observers to report thunderstorms; (2), many do not report consistently during the year, that is to say, they report in some months and not in others, and (3), in some States a greater proportion of observers report than in others. There should, however, be some sort of agreement between the figures of Tables V and VI.

As a means of testing the agreement or disagreement between the data of Tables V and VI, two sets of figures have been entered on Chart V, viz, the red figures which indicate the total thunderstorm days as given by Table VI, and the black figures which stand for the total thunderstorm days recorded at individual stations in the several States and Territories as shown by Table V.

It is obvious from an inspection of Chart V, that so far as determining the the relative frequency of thunderstorms is concerned, the figures of either Table V or VI may be used. But if we desire to ascertain the absolute number of storms in any single neighborhood, the use of the figures giving the total number of thunderstorms per year per state would lead to erroneous conclusions because the local variations peculiar to some of the larger states are obscured; and also because the method of obtaining the totals for the states necessarily gives the same weight to a single isolated storm that would be given to a group of storms covering a comparatively large area. For these and other reasons we are inclined to give the greater weight to the totals for individual stations.

The results for 1898 show a decided maximum of thunderstorms in the lower Mississippi Valley and Missouri, with secondary maxima in Georgia, South Carolina, Florida, the Valley of Virginia, and portions of New Mexico and Arizona. In the last-named regions the storms are almost wholly confined to the months of July and August. The number of thunderstorms as a rule is least west of the Rocky Mountains and in northern New England. A secondary minimum occurs on the middle Atlantic coast north of Hatteras. South of the last-named point the number of storms on the coast and the regions adjacent thereto increases quite sharply.

Following is a brief account of the principal tornadoes of the year:

The Fort Smith, Ark., tornado.—Occurred at 12:42 a. m. (local time), January 12. Persons killed, 52; injured, 73; property loss estimated at $450,000. This was not an unusually severe tornado. The large loss of life is accounted for by the fact that it came at the dead of night when there was no opportunity to seek places of safety.

The Iowa and Nebraska tornadoes of April 30.—Six persons killed and as many more injured. Several independent tornadoes appear to have formed in northeastern Nebraska, and moved in parallel paths northeastward into Iowa where they disappeared about 6:30 p. m., central time.